

USB 3.0 ENGINEERING CHANGE NOTICE

ECN# 010

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USB 3.0 ENGINEERING CHANGE NOTICE

Title: DSPORT State Machine

Applied to: USB3.0 (11132008)-final

Brief description of the functional changes proposed::

To avoid DS devices from dropping to 2.0 during the "DSPORT.Powered-off" state and possibly requiring the end user to cycle power on the DS device(s) to reconnect them as SS, 2 new states of "DSPORT.Powered-off-reset" and "DSPORT.Powered-off-detect" have been added. For conditions where the DS port is truly powered off and, thus, cannot switch to 2.0 and for the one condition for which it is desired for the DS device to switch to 2.0, the original states (for which the link is in SS.Disabled) are maintained. The DS port power may or may not be off in the new states as well as the original state. Considering the indeterminate status of DS port power, it is desirable to keep the link state simple for guaranteed behavior by the DS device. To that end, the link state is either warm reset or receiver detect.

Benefits as a result of the proposed changes:

Neither the system nor the end user has to intervene to guarantee DS devices connect at SS in these circumstances.

An assessment of the impact to the existing revision and systems that currently conform to the USB specification:

Existing DS ports (excluding those of root hubs) will not be compliant to the new release of the USB 3.0 standard which includes this ECR. However, they will be compliant to the original USB 3.0 standard.

Existing US ports must tolerate the DS-facing port toggling between warm reset and receiver detection.

An analysis of the hardware implications:

The DSPORT state machine of hubs primarily and to a lesser extent hosts will be impacted. The state machine now needs to consider whether the hub supports power switching and may consume more power while signaling warm reset.

There is no change to Upstream ports.

An analysis of the software implications:

None. Potential SW problems are averted.

An analysis of the compliance testing implications:

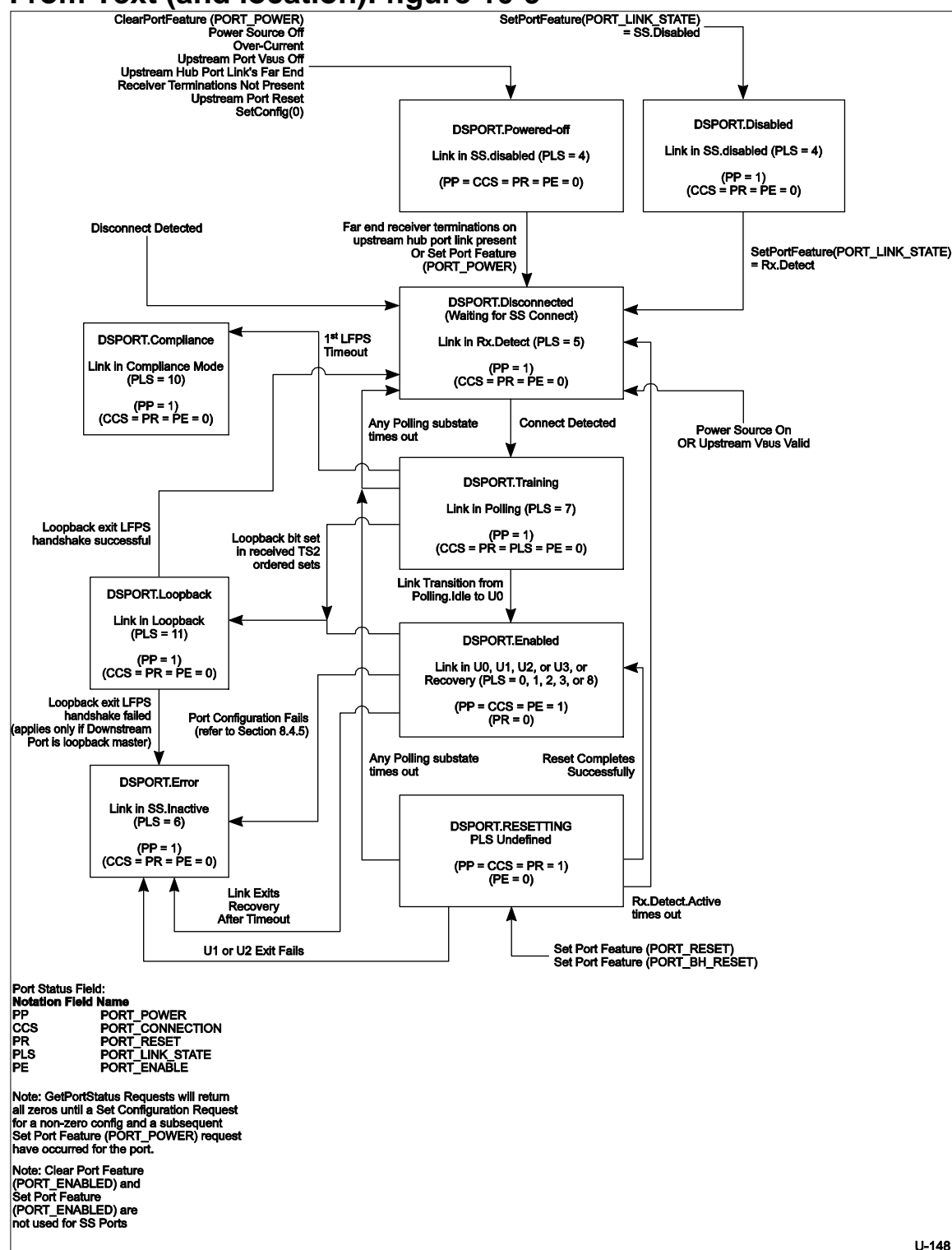
USB 3.0 ENGINEERING CHANGE NOTICE

Test the new DSPORT.Powered-off-reset and DSPORT.Powered-off-detect states. Confirm that warm reset is signaled for tReset duration and whether power is on or off while in the DSPORT.Powered-off-reset state. Confirm that the DSPORT.Powered-off-reset state is exited after tReset time to either DSPORT.Powered-off-detect or DSPORT.Disconnected, depending on repower conditions. Test that receiver detection is performed repetitively during the DSPORT.Powered-off-detect state until a connection is detected or conditions to repower are met.

USB 3.0 ENGINEERING CHANGE NOTICE

Actual Change Requested

From Text (and location): figure 10-9



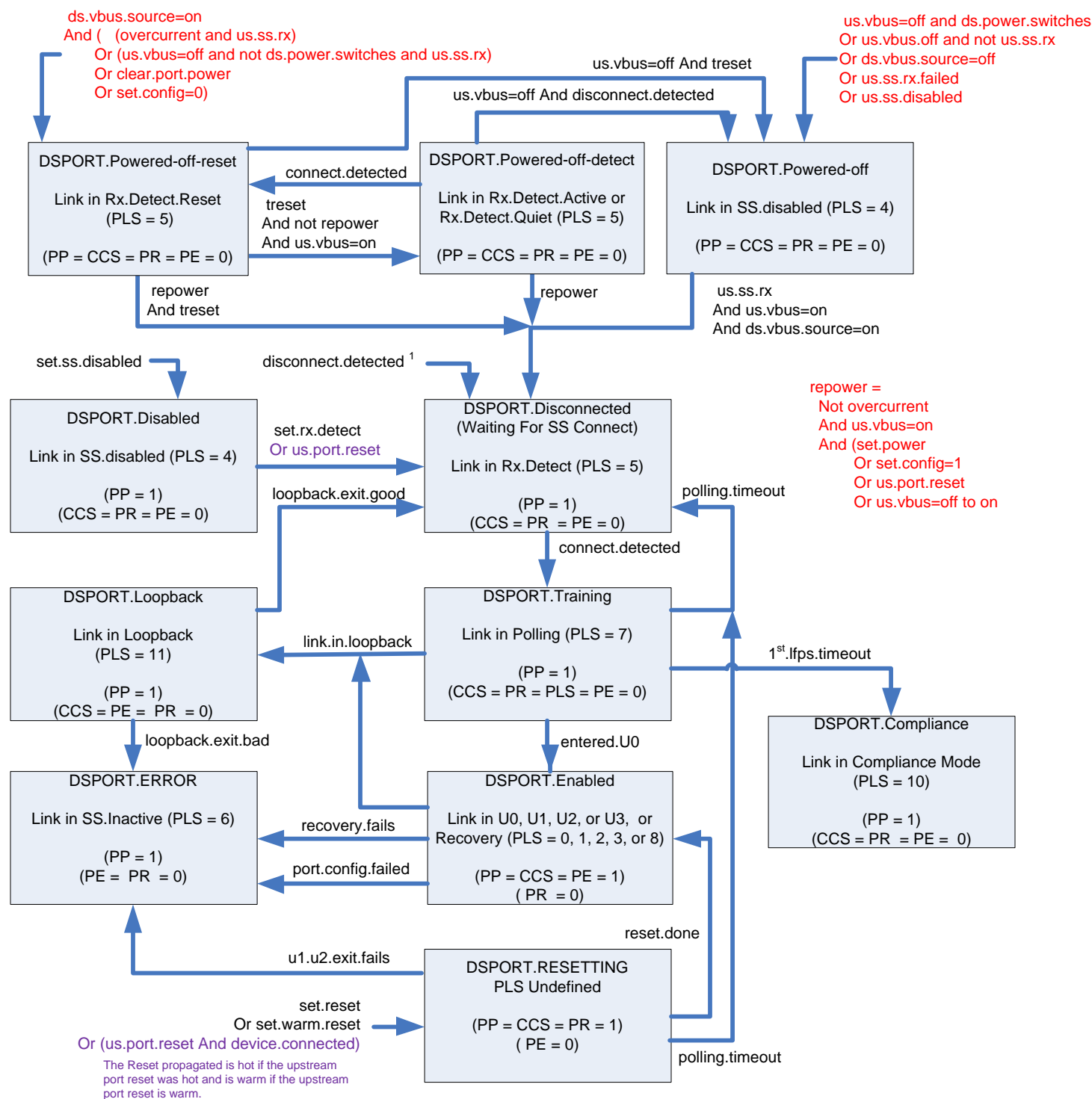
USB 3.0 ENGINEERING CHANGE NOTICE

To Text (and location):

Table 10-0. Downstream Facing Hub Port State Machine Diagram Legend

| Key | Description |
|---------------------|--|
| 1st.lfps.timeout | First LFPS Timeout |
| clear.port.power | Received ClearPortFeature(PORT_POWER) |
| connect.detected | Connect Detected |
| device.connected | Device is connected |
| disconnect.detected | Disconnect Detected |
| ds.power.switches | Hub reports non-zero value in bPwrOn2PwrGood field of hub descriptor. Hub supports power switching. |
| ds.vbus.source=off | Downstream port VBUS is Off due to loss of Local Power Source when hub is self-powered. |
| ds.vbus.source=on | Downstream port VBUS may be On. Local Power Source is On or the hub is bus-powered. |
| entered.U0 | Link Transitions from Polling.Idle to U0 |
| link.in.loopback | Loopback bit set in received TS2 ordered sets |
| loopback.exit.bad | Loopback exit LFPS handshake failed (applies only if Downstream Port is loopback master) |
| loopback.exit.good | Loopback exit LFPS handshake successful |
| overcurrent | Over-Current is active. |
| polling.timeout | Any Polling substate times out |
| port.config.failed | Port Configuration Fails (refer to Section 8.4.5) |
| recovery.fails | Link Exits Recovery after Timeout |
| repower | Repowering conditions defined in 10.3.1.10 are met. |
| reset.done | Reset Completes Successfully |
| set.config=0 | Received SetConfig(0) request. |
| set.config=1 | Received SetConfig(1) request. |
| set.port.power | Received SetPortFeature(PORT_POWER) |
| set.reset | Received SetPortFeature(PORT_RESET) |
| set.rx.detect | Received SetPortFeature(PORT_LINK_STATE) = Rx.Detect |
| set.ss.disabled | Received SetPortFeature(PORT_LINK_STATE) = SS.Disabled |
| set.warm.reset | Received SetPortFeature(PORT_BH_RESET) |
| treset | Warm Reset has been signalled for tReset duration. |
| us.port.reset | Received inband reset on Upstream Port |
| us.ss.disabled | Upstream port transitioned to SS.Disabled. |
| us.ss.rx | Far End Receiver Terminations are present on the Upstream Port's link or were present when Upstream VBUS was most recently on. |
| us.ss.rx.failed | Hub's upstream port link has attempted eight consecutive Rx.Detect events without detecting far-end receiver termination |
| us.vbus=off | Upstream port VBUS is Off |
| us.vbus=on | Upstream port VBUS is On |
| u1.u2.exit.fails | U1 or U2 Exit Fails |

USB 3.0 ENGINEERING CHANGE NOTICE



USB 3.0 ENGINEERING CHANGE NOTICE

From Text (and location) 10.3.1.1:

10.3.1.1 DSPORT.Powered-off

The DSPORT.Powered-off state is a logical powered off state. The hub may still be required or choose to provide VBUS for a downstream port in the DSPORT.Powered-off state. Detailed requirements for presence of VBUS are covered later in this section. A port shall transition into this state if any of the following situations occur:

- From any state when the hub receives a ClearPortFeature(PORT_POWER) request for this port. In this case, power is only removed from the port if it would not impact the low-speed, full-speed, or high-speed operation on any of the downstream ports on the hub and would not impact SS operation on any ports other than the target port.
- From any state when local power is lost to the port or an over-current condition exists.
- From any state when VBUS is removed from the hub upstream port.
- From any state if the hub's upstream port link transitions to the SS.Disabled state.
- From any state if the hub's upstream port link has attempted eight consecutive Rx.Detect events without detecting far-end receiver terminations.
- From any state if the hub upstream port receives a SetConfiguration(0) request. In this case the downstream port remains in the DSPORT.Powered-off state regardless of other conditions until the hub is reset or the hub upstream port receives a non-zero SetConfiguration request. After a non-zero SetConfiguration request is received, the normal state machine rules apply.

A port will enter the DSPORT.Powered-off state due to an over-current condition on another port if that over-current condition may have caused the power supplied to this port to drop below specified limits for port.

If a hub was configured while the local power supply was present and then if local power is lost, the hub shall place all ports in the Powered-off state if power remains to run the hub controller.

To Text (and location) 10.3.1.1:

The DSPORT.Powered-off state is a logical powered off state. The hub may still be required or choose to provide VBUS for a downstream port in the DSPORT.Powered-off state. Detailed requirements for presence of VBUS are covered later in this section. A port shall transition into this state if any of the following situations occur:

- From any state when local power is lost to the port.
- From any state when VBUS is removed from the hub upstream port and the hub supports power switching on the DS ports.
- From any state if the hub's upstream port link transitions to the SS.Disabled state and Upstream Port VBUS is on.
- From any state if the hub's upstream port link has attempted eight consecutive Rx.Detect events without detecting far-end receiver terminations.
- From the DSPORT.Powered-off-detect state if the hub's Upstream Port Vbus is Off, the hub does not support power switching and far-end receiver detection has failed on the downstream port and the conditions for Repowering defined in section 10.3.1.10 are not met.
- From the DSPORT.Powered-off-reset state if the hub's Upstream Port Vbus is Off, the hub does not support power switching, conditions for Repowering defined in section 10.3.1.10 are not met and the DSPORT.Powered-off-reset state has been maintained for tReset

A port shall remain in the DSPORT.Powered-off state until the following conditions are met.

- The hub's Upstream Port link has detected far-end receiver terminations. Note that this requires Upstream Port VBUS to be on.
- Power is available for the downstream port. This is true if the hub is bus-powered or the local power source is on.

From Text (and location) section 10.3.1.2:

USB 3.0 ENGINEERING CHANGE NOTICE

10.3.1.2 DSPORT.Disconnected (Waiting for SS Connect)

This is the default state when local power is valid (self-powered) or VBUS becomes valid (bus-powered). A port transitions to this state in any of the following situations:

- From the DSPORT.Powered-off state when the hub receives a SetPortFeature(PORT_POWER) request.
- From any state except the DSPORT.Powered-off state when the port detects a disconnect.
- From the DSPORT.Powered-off state when the hub upstream port's link transitions from Rx.Detect to the polling state.
- From the DSPORT.Resetting state when a port's link times out from Rx.Detect.Active during a reset.
- From the DSPORT.Disabled state when a SetPortFeature(PORT_LINK_STATE) Rx.Detect request is received for the port.
- From the DSPORT.Resetting state if the port's link times out from any Polling substate during a reset.
- From the DSPORT.Training state if the port's link times out from any Polling substate.
- From the DSPORT.Loopback state if the port's link performs a successful LFPS handshake in Loopback.Exit.

To Text (and location) section 10.3.1.2:

10.3.1.2 DSPORT.Disconnected (Waiting for SS Connect)

This is the default state when local power is valid (self-powered) or VBUS becomes valid (bus-powered). A port transitions to this state in any of the following situations:

- From the DSPORT.Powered-off state when the hub's Upstream Port link has detected far-end receiver terminations, Upstream Port VBUS is on (implied by receiver detection) and power is available for the downstream port. Power is available for the downstream port if the hub is bus-powered or if the local power source is on.
- From any state that can and does detect a disconnect, except from DSPORT.Powered-off-detect. For a port to detect a disconnect, it must be in a state for which its current connect status, CCS, is 1.
- From the DSPORT.Powered-off-reset state when conditions for Repowering defined in section 10.3.1.10 are met and the DSPORT.Powered-off-reset state has been maintained for tReset.
- From the DSPORT.Powered-off-detect state when conditions for Repowering defined in section 10.3.1.10 are met.
- From the DSPORT.Resetting state when a port's link times out from Rx.Detect.Active during a reset. That is, it detects a disconnect.
- From the DSPORT.Disabled state when a SetPortFeature(PORT_LINK_STATE) Rx.Detect request is received for the port.
- From the DSPORT.Resetting state if the port's link times out from any Polling substate during a reset.
- From the DSPORT.Training state if the port's link times out from any Polling substate.
- From the DSPORT.Loopback state if the port's link performs a successful LFPS handshake in Loopback.Exit.

New Text (and location) section 10.3.1.10:

10.3.1.10 DSPORT.Powered-off-detect

This state is entered when the downstream power state is logically off and a SS, rather than USB 2.0 connection, is desired. To ensure that a SuperSpeed connection is established, unlike the DSPORT.Powered-off state, SS terminations are maintained while in this state. This state shall perform far-end receiver detection with the link in Rx.Detect, until any of the following conditions are true:

- A receiver is detected.

USB 3.0 ENGINEERING CHANGE NOTICE

- The conditions for Repowering the port as described below are met.
- Upstream Port VBUS is off, the hub does not support power switching and receiver detection has failed.

A port shall transition into this state from the DSPORT.Powered-off-reset state when tReset time has been met and the conditions for Repowering are not met.

All the following conditions shall be met for Repowering:

- No overcurrent condition is active.
- Upstream Port VBUS is on.
- SetPortFeature(PORT_POWER) request is received,
Or SetConfig(1) request is received,
Or Upstream Port Reset is detected,
Or Upstream Port VBUS transitioned from off to on.

New Text (and location) section 10.3.1.11:

10.3.1.11 DSPORT.Powered-off-reset

This state is entered when the downstream power state is logically off and a SS, rather than USB 2.0 connection, is desired. To ensure that a SuperSpeed connection is established, unlike the DSPORT.Powered-off state, the SS terminations are maintained while in this state, and to avoid a link training failure, which would allow the downstream device to drop into Compliance Mode or USB 2.0 operation, Warm Reset signaling shall be driven for tReset duration. This state shall drive Warm Reset with the link in the Rx.Detect.Reset substate, until the tReset duration is met.

When any of the following conditions are true, this state is entered regardless of the previous state.

- Overcurrent condition is detected either on this port or globally and Upstream Port Far-end Receiver Terminations are present or were present when Upstream VBUS was last on.
- Upstream Port VBUS is off and hub does not support power switching and Upstream Port Far-end Receiver Terminations were present when Upstream VBUS was last on .
- The hub receives a ClearPortFeature(PORT_POWER) request for this port. In this case, power is removed from the port only if it would not impact the low-speed, full-speed, or high-speed operation on any of the downstream ports on the hub and would not impact SS operation on any ports other than the target port.
- The hub upstream port receives a SetConfiguration(0) request. In this case the downstream port will stay in this state or transition between this state and DSPORT.Powered-off-reset state regardless of other conditions until the hub is reset or the hub upstream port receives a non-zero SetConfiguration request.

From Text (and location) section 10.10.1:

When an over-current condition occurs on an over-current protection device, the over-current is signaled on all ports that are protected by that device. When the over-current is signaled, all the ports in the group are placed in the DSPORT.Powered-off state, and the C_PORT_OVER_CURRENT field is set to one on all the ports. When port status is read from any port in the group, the PORT_OVER_CURRENT field will be set to one as long as the over-current condition exists. The C_PORT_OVER_CURRENT field shall be cleared in each port individually. When multiple ports share a power switch, setting PORT_POWER on any port in the group will cause the power to all ports in the group to turn on. It will not, however, cause the other ports in that group to leave the DSPORT.Powered-off state.

To Text (and location) section 10.10.1:

When an over-current condition occurs on an over-current protection device, the over-current is

USB 3.0 ENGINEERING CHANGE NOTICE

signaled on all ports that are protected by that device. When the over-current is signaled, all the ports in the group are placed in the DSPORT.Powered-off or the DSPORT.Powered-off-reset state, and the C_PORT_OVER_CURRENT field is set to one on all the ports. When port status is read from any port in the group, the PORT_OVER_CURRENT field will be set to one as long as the over-current condition exists. The C_PORT_OVER_CURRENT field shall be cleared in each port individually. When multiple ports share a power switch, setting PORT_POWER on any port in the group will cause the power to all ports in the group to turn on. It will not, however, cause the other ports in that group to leave the DSPORT.Powered-off or the DSPORT.Powered-off-reset state.

From Text (and location) section 10.11.5:

When a hub experiences an over-current condition, it shall place all affected ports in the DSPORT.Powered-off state. If a hub has per-port power switching and per-port current limiting, an over-current condition on one port may still cause the power on another port to fall below specified minimums. In this case, the affected port is placed in the DSPORT.Powered-off state

To Text (and location) section 10.11.5:

When a hub experiences an over-current condition, it shall place all affected ports in the DSPORT.Powered-off or the DSPORT.Powered-off-reset state. If a hub has per-port power switching and per-port current limiting, an over-current condition on one port may still cause the power on another port to fall below specified minimums. In this case, the affected port is placed in the DSPORT.Powered-off or the DSPORT.Powered-off-reset state

From Text (and location) section 10.14.2.2:

Clearing the PORT_POWER feature causes the port to be placed in the DSPORT.Powered-off state and may, subject to the constraints due to the hub's method of power switching, result in power being removed from the port. When in the DSPORT.Powered-off state, the only requests that are valid when this port is the recipient are Get Port Status (refer to Section 10.14.2.6) and Set Port Feature (PORT_POWER) (refer to Section 10.14.2.10).

To Text (and location) section 10.14.2.2:

Clearing the PORT_POWER feature causes the port to be placed in the DSPORT.Powered-off-reset state and may, subject to the constraints due to the hub's method of power switching, result in power being removed from the port. When in the DSPORT.Powered-off or the DSPORT.Powered-off-detect or the DSPORT.Powered-off-reset state, the only requests that are valid when this port is the recipient are Get Port Status (refer to Section 10.14.2.6) and Set Port Feature (PORT_POWER) (refer to Section 10.14.2.10).

From Text (and location) section 10.14.2.6:

PORT_POWER

This bit reflects the current logical power state of a port. This bit is implemented on all ports whether or not actual port power switching devices are present.

While this bit is zero, the port is in the DSPORT.Powered-off state. Similarly, anything that causes

USB 3.0 ENGINEERING CHANGE NOTICE

this port to go to the DSPORT.Powered-off state will cause this bit to be set to zero.

C_PORT_OVER_CURRENT

This bit is set to one when the PORT_OVER_CURRENT bit changes from zero to one or from one to zero. This bit is also set if the port is placed in the DSPORT.Powered-off state due to an overcurrent condition on another port.

This bit shall be set to zero by a ClearPortFeature(C_PORT_OVER_CURRENT) request or while logical port power is off and when the port is in the DSPORT.Powered-off state.

To Text (and location) section 10.14.2.6:

PORT_POWER

This bit reflects the current logical power state of a port. This bit is implemented on all ports whether or not actual port power switching devices are present.

While this bit is zero, the port is in the DSPORT.Powered-off state, the DSPORT.Powered-off-detect or the DSPORT.Powered-off-reset. Similarly, anything that causes this port to go to any of these 3 states will cause this bit to be set to zero.

C_PORT_OVER_CURRENT

This bit is set to one when the PORT_OVER_CURRENT bit changes from zero to one or from one to zero. This bit is also set if the port is placed in the DSPORT.Powered-off, the DSPORT.Powered-off-detect or the DSPORT.Powered-off-reset state due to an overcurrent condition on another port.

This bit shall be set to zero by a ClearPortFeature(C_PORT_OVER_CURRENT) request

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